MINISTRY OF THE ENVIRONMENT

SCIENTIFIC RESEARCH NEEDS

October 1984

(REPRINTED WITH ADDENDUM, NOVEMBER, 1986)

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1984

Ministry
of the
Environment

Ontario

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TO ALL RESEARCHERS

The Ministry of the Environment's Scientific Research Needs document was originally published in October, 1984. This has been expanded by adding new sections to cover a fifth research category, Socio-Economics, and a number of additional, important research priorities, complementary to major new Ministry programs.

Please note the following:

1. In 1987 there will be two deadlines for submitting proposals: January 15 and June 15. Following technical review of the proposals, the R.A.C. will meet in early April and early September to make recommendations on the funding of these proposals, and the applicants will be notified of the outcome shortly thereafter (usually within 2 to 4 weeks). This is intended to assist researchers in planning field work and in hiring, and will help accelerate the Ministry's review process. Researchers are encouraged to submit proposals in advance of the deadline. Comments on the suitability of the timing of these dates for future years would be welcome.

2. The original and four copies of the research proposal should accompany the completed Form 02.

3. Grant recipients must provide an audited statement of expenditures at the end of each fiscal year (March 31) to the Liaison Officer with a copy to the Research Management office.

4. Applicants are to agree to provide a written progress report every six months in addition to a final report which details the entire project and must be approved by the Ministry.

5. Approval for the second or third year of multi-year projects is contingent upon a satisfactory progress report and written recommendation by the liaison officer.

6. Revisions and additions to the 1984 document have been included as an addendum starting on page 34 with reference to the original text where necessary.

It is anticipated that 1987 will be a year of growth for the Ministry's Research Coordination process, with several changes anticipated, including a streamlined review process, major revisions in Form 02, a 1987 version of the Scientific Research Needs, a booklet on Guidelines for Submission of Research Proposals, and an annual research inventory.

Please direct any questions or comments to the Research Management Office.

Jane Pagel

Jane E. Pagel
Coordinator,
Research Management
November, 1986

[NOTE: Effective December 15, 1986 the Research Management Office numbers will be:

(416) 323-4573 - Dr. Mike Moselhy (Research Analyst)
(416) 323-4574 - Gulshan Ishani (Secretary)
(416) 323-4576 - Jane Pagel (Coordinator)]

PLANNING OF SCIENTIFIC RESEARCH

MINISTRY OF THE ENVIRONMENT

RESEARCH NEEDS

OCTOBER 1984

POLICY AND PLANNING BRANCH

RESEARCH COORDINATION OFFICE

(REPRINTED WITH ADDENDUM, NOVEMBER, 1986)

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(02) and (03)

This report presents a summary of 1985-86 scientific research needs of the Ontario Ministry of the Environment. The document has been prepared and updated to assist university researchers interested in submitting requests for financial grants in support of environmental research.

The updated list of research needs is classified into four research categories: Air Pollution, Water Pollution, Liquid and Solid Waste Research, and Analytical Methods and Equipment Development.

The following Appendix presents some information on the current projects including titles, objectives and description.

Some guidelines for the preparation of proposal and attachments are also presented herewith.

Applicants are advised that their proposal(s) will be evaluated, not only on scientific merits, but also on the adherence to Ministry research requirements and priorities. The latter is an essential part of MOE Research Planning Process which has been designed to:

- ensure that research is consistent with MOE goals;
- set up procedures for management and coordination of research activities;
- evaluate research performance; and
- ensure that research results are publicized and new technology is put to use.

It is hoped, with your cooperation, to complete the selection of successful proposals before the end of March 1985.

Information On Application For Grants:

Applications for funding of research proposals by grants should be submitted to the Research Coordination Office, Policy and Planning Branch, Ministry of the Environment. The original and three copies of the research proposal should accompany a completed form 02 including the required signatures of the Office of Research Administration of the University etc.

For further information, please direct your enquiries to:

Research Coordination Office
Policy and Planning Branch
Ontario Ministry of the Environment
135 St. Clair Avenue West
Toronto, Ontario
M4V 1P5
Tel: (416) 965-5788

2) Information on Application for grant:

Items Covered By a Research Grant:

Research Grants are intended primarily to cover operation expenses such as: employment of assistants, supplies, computer services, field trips, and equipment. It is assumed that the basic facilities required to carry out the proposed work are already available to the applicant. Capital equipment may be purchased with Grant funds although this type of approved expense should not exceed 50% of the total budget. This equipment remains the property of the Crown and must be returned to the Ministry unless arrangements are made to loan the equipment for a defined period of time.

Conditions For Academic Faculty and Staff

All research proposals, before submission to the Ministry, must be handled through University or College Research Administration Office which is held accountable for the grant funds.

In the event that any principal researcher specified in an approved project takes a sabbatical leave, leave of absence, or will otherwise not be present or active in the project, agreement should be made in writing with the Liaison Officer and the Research Coordination Office on the investigator's substitute, deferring, continuation, or termination of the project.

It is assumed that time of academics is a university property, and thereby they are not paid for their role in the project.

Application Format:

Applications for grants must be supported by detailed information showing:

a. A proposed title which briefly reflects the proposed activity;

b. A lucid statement of objectives;

c. A general description of the proposed study, its significance and relevance to environmental and health-related research, science or technology, or the protection of the total environment;

d. A concise statement of the work program, its start and completion date;

e. A succinct and clear statement of what will be achieved in each year of the proposal;

f. Statement of the benefits to MOE objectives and programs;

g. A detailed budgetary statement with cash flows shown for each year and normally based on the government fiscal year from April 1 to March 31st;

h. The names of principal and junior investigator(s);

i. A brief resume of the principal investigator(s) accompanied with a list and copies of recent publications;

j. Special capital equipment available to the researcher or to be acquired;

k. A signed acceptance on form or of the conditions of funding, including signatures of the principal investigator, the head of the research administration office etc.;

l. The original and three copies of signed application form and research proposals are required in submissions for funding by grants. In the case of contracts, the number of required copies is included in the terms of "Request For Proposal".

Salaries

The principal investigator(s) and other senior research staff associated with the project who normally receive a salary on a continuing basis from a university or college are not to receive salary payments, stipends, supplements or fees for services from these Grants.

Salary payments to post doctoral fellows, graduate students, technicians or other assistants should not exceed existing NSERC rates.

Alternate or Ancillary Funding:

Applicants must indicate whether funds for all or part of the submitted proposal or a similar project have been, or are going to be solicited or funded elsewhere. The following information should be presented:

- Names of other agencies;
- Amount sought from each agency; and
- Funds received to date from each agency.

Should any funds be approved by another agency during the submission or after approval of a project, grantees must inform the Ministry Liaison Officer in writing.

Joint funding of grant project by the Ministry with other government agencies is possible and is encouraged. it is in the interest of an applicant to suggest if other agencies will cooperate in joint funding and notify the Ministry if such arrangements appear possible.

The Ministry may take action to arrange partnership funding of a proposal if such a step is considered expedient.

Duration of Funding by Grants:

A proposal usually receives approval for the duration described in the submission form up to thirty six months from its approval. The awarding of a multi-year grant in any one year does not imply that funding will be certain in subsequent years at the end of each year. Grantees are required to annually establish their continued interest in the research and that it has been carried out satisfactorily by a letter to the Research Coordination Office accompanied with copies of progress report(s), a list of purchased equipment, and a Financial Statement of Expenditure signed by their Research Administration.

Ministry decision for continuation of funding will be conveyed to the Director of Research Administration of the institution and the Principal Investigator.

3. Summary of Research Needs:

- Air Pollution;
- Water Pollution;
- Liquid & Solid Waste Research;
- Analytical Methods & Equipment Development.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
1 Issue/ Subject	Hazard and risk due to airborne contaminants.	Lack of information on the biological response to contamination from industrial and municipal discharges.	Leachate collection, control and treatment technologies.	Broad spectrum screening Methods for contaminants in drinking, surface, and waste waters.
Type of Research Needed	- Studies (including short-term tests) of contaminant effects on receptors, humans, mammals, vegetation/soils, and/or biological systems. - Development of novel methods of collating and displaying hazardous contaminants information.	- in situ and ecosystem indicators of water quality impairment. - development of predictive toxicological-dose response relationship for populations/communities of aquatic organisms based on contaminant structure. - mutagenic and carcinogenic testing related to aquatic populations and human risk. - Application of predictive models to relate concentrations of priority pollutants in point sources (eg. sewage effluents) to their final concentrations in the receiving water and vise-versa.	- measurement of leakage by-passing tile system (field study). - efficiency of purge well. - leakage through earth liners. - assessment of leachate leakage from secure landfills. - definition of critical factors for leachate plume. - field testing of monitoring systems and materials with emphasis on complex organic chemicals. - methods for leachate control: infiltration, generation, cover, liner design, effectiveness and remedial measures. - Evaluation of treatment and disposal methods: physical, chemical, biological, recycling, etc.	Development of: - ICP - MS - GC - Microwave Plasma Emission Spectrometry - Ion specific mass detector and other broad-spectrum screening tools - Biological on-line monitoring

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
2 Issue/ Subject	Relationship between inhalable particulate and effects on human health.	Standard protocol for prediction of fate and removability of hazardous compounds in municipal Water Pollution Control Plants.	Destruction of municipal and indistrial wastes by incineration.	Determination of organic vapours in air samples.
Type of Research Needed	- Examination of effects of inhalable particulate on human health for application to standard setting, e.g. blood lead, respiratory function, etc.	Use of model compound-behaviours to determine fate and treatability of other compounds. What means can be effectively used to predict fate and treatability of waste water. Assessment of the fate, removability and stability of hazardous contaminants during and after sludge treatment.	- Improvements to state-of-the-art technology - Field and laboratory studies. - Technology for destruction and disposal of municipal and industrial wastes. - Characterization of incinerator ash, its leachability and utilization or disposal. - Effectiveness of existing incineration facilities. - Emission monitoring of hazardous contaminants.	Broad spectrum screening methods to extend the range of compounds currently monitored and to provide a more rapid and cost effective approach to analysis of organic air pollutants. Improved specificity, speed and cost of analytical methods.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
3 Issue/Subject	Improvement of routine, non-routine, and mobile monitoring techniques.	Removal capabilities of treatment techniques for specific trace contaminants in drinking water.	Indications of long-term degradation of solidified encapsulated fixed waste. Long-term impact on waste site is difficult to decide based on simple leachate extraction tests.	Development and validation of sampling protocols for contaminants in surface and drinking waters.
Type of Research Needed	- Further development of mobile monitoring analytical methods for an increased number of compounds and validate methods. - Rugged, simple, field monitoring technicques for a variety of organic and inorganic compounds. - Passive sampling techniques.	- Evaluate effectiveness of resin adsorption, reverse osmosis, aeration, and biological filtration as treatment processes for hazardous contaminant removal. - Protocol development for the assessment of treatment methodologies for groups of compounds and specific trace contaminants.	- Long-term integrity of solidified waste	- To determine significance of sampling protocols on analytical data. - Protocols should also consider microbiological parameters other than the standard coliforms etc. - Development/evaluation of samplers for collection of liquid samples (sewage effluent, drinking watr, etc) for purgeable organic analysis.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
4 Issue/ Subject	Development of long-range and meso-scale atmospheric transport modelling to predict the impact of pollutants on receptors, and assess contributions of different sources to air pollution problems.	Insufficient data available on the persistence and migration and breakdown processes of select hazardous contaminants in soil and groundwater.	Landfill cover infiltration and effects on: - leachate production. - waste decomposition. - leakage of leachates from secure landfills. - mass transport through clay-type soil.	Investigation and development of laboratory techniques to assess leaching potential of specific wastes for hazardous waste classification.
Type of Research Needed	- Further model development	Laboratory and field tests of half-life and migration of various hazardous contaminants in the various soil and groundwater conditions found in Ontario, including the effects of complex mixtures that might be found in industrial waste disposal sites; eg. additive effects of several substances or increased mobility due to the presence of solvents.	- Field measurements using developed instruments. - Development and evaluation of landfill cover designs in terms of: i. material ii. thickness iii. shape iv. infiltration, etc.	- Serial leaching of specific wastes to determine the effect on contaminant concentration. - Development of a simplified procedure to determine the effect of long term (serial) leaching. - Review of parameters such as pH, time, oxygen, liquid to solids ratio, etc. to improve the ability of the procedure to approximate actual site conditions.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
5 Issue/ Subject	Improvement of methods of risk assessment in connection with air pollution.	Paucity of epidemiological information relating pathogens and their effects on humans and other animals by ingestion and by other means (e.g. recreational).	Suitability of backfilling (inert) waste. Difficulties in allowing certain wastes to be used for construction purposes.	PAH analysis for air and air particulates.
Type of Research Needed	- Development of methodology for risk assessment due to air pollutant exposure.	a. Relationships between indicator organisms and human epidemiology. b. Resistance of specific pathogens to disinfection practices in drinking and waste water treatment plants. c. What represents an effective dose of major waterborne pathogens on humans? d. Impact of pathogens on aquatic and domestic animals. e. Define the significance/ effects of photoreactivation of Indicator organisms and pathogens in surface waters which receive sewage effluent f. Disinfection by means of ultraviolet light plus either ozone or peroxide.	- Criteria for use in construction applications.	- Development of broad spectrum screening methods to extend the range of PAHs currently monitored with emphasis on specificity. - Development of cost-effective analytical methods for PAH's.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
6 Issue/ Subject	Effects in Ontario of sulphur and nitrogen compounds and acids transported in the atmosphere.	The impacts of in-place pollutants in sediments on the aquatic ecosystem and human health.	Development of a method to assess methane flux in landfill. Development of guidelines for the management of gas migration.	Analysis of hazardous chemicals in complex industrial wastes.
Type of Research Needed	- Further work to increase our understanding of Atmospheric Chemistry and deposition, e.g. studies of chemical reactions in clouds, studies of ozone formation around industrial areas in Ontario, wet and dry deposition measurements.	1. Measurements of uptake by and release from sediments of trace substances. 2. Transformation of trace organics and inorganics in sediments. 3. Availability of trace organics and heavy metals in sediments to biota. 4. Measurement and modelling of sediment resuspension and redistribution due to wave action, storms and currents. 5. Development of criteria for evaluation and control of pollutants in sediments of receiving waters. 6. Contaminant breakdown processes in sediments, such as biodegradation. 7. Immobilization techniques such as chemical fixation, overlaying with clean segment.	Specific measurements of ventilation rates and flux.	Analytical methods must be developed for contaminants listed in Table 1 of the Interim Hazardous Waste Guideline and for the priority list prepared by the Hazardous Contaminants and Standards Branch.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
7 Issue/ Subject	Assessment of human exposure to selected contaminants using data from fixed central monitoring stations.	Natural occurrence of some organic and inorganic contaminants (e.g. heavy metals, phenols, fluorides, radioactive materials) in surface and ground waters.	Impact on groundwater from chemical spills and spill clean-up technology.	Genotoxicity testing
Type of Research Needed	- More sensitive personal dosimeters need to be developed for a variety of contaminants. - To examine relationships between fixed central stations measurements and human health effects.	Determine sources and availability of trace metals, fluoride, radon, from specific geological formations, e.g. limestone, igneous rocks. Evaluate the significance of substances such as phenols produced by the decay of vegetation on aquatic life - (tainting, toxicity).	- State-of-the-art reviews - Case histories	- In-situ test systems needed to identify the presence of genotoxic compounds or conditions (mixture effects) in the environment. - Screening tests that can be quickly and economically carried out on environmental samples are required for laboratory application. - Relationships need to be developed between carcinogenicity and genotoxicity test response and human health effects.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
8 Issue/ Subject	Insufficient information on the sources and fate of hazardous contaminants.	Information is needed on impact of suspended solids and sediment on stream use.	Accumulation of non-degradable contaminants on land (inorganics and organics)	Biological toxicity testing
Type of Research Needed	- Determination of hazardous contaminants sources, source strengths, sink mechanisms and strengths, atmospheric persistence and fate.	Case studies of streams to assess impacts of siltation on stream ecology, recreational potential and fishery resources. Potential for fine-grain sediments in removing trace contaminants from the water column (adsorption) and immobilizing these materials in the sediment.	- To establish criteria for defining acceptable levels. - To develop remedial (resoration) methods.	- Standardized on-site integrative biological tests to identify potential problem areas in air, soil and water. - Development of laboratory protocols for recovery, identification, and enumeration of pathogenic organisms (virus, bacteria, protozoa) - Field methods for pre-concentration of viruses

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
9 Issue/ Subject	Improvement of current sampling methods for volatile metals and organometallics in ambient air.	Impact of organic compounds in pulp and paper discharges on aquatic life and fish consumption.	Environmental and health implications from burning of railway ties.	Surrogate parameters for water monitoring.
Type of Research Needed	- Sampling methodology needs development and validation.	- Developmental work required to identify and quantify compounds of significance, followed by assessment of effects on aquatic life. - Toxicity and uptake studies as well as depuration rate studies are required, relative to industrial and in-place pollutants. - Identification of tainting compounds. - Study of the toxicity of effluent from thermo-mechanical pulping and sulfide mill, for use in establishing criteria for mill effluents. - To develop technology for detoxification and treatment of effluents.	- To develop methods to qualify emissions.	Development and improvement of detection limits of surrogate parameters and correlation with specific and group toxic compounds in drinking and waste waters.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
10 Issue/ Subject	Stack and emission sampling is extremely expensive.	Identification of Klebsiella pneumoniae and other micro-organisms in pulp and paper mill effluent and other carbohydrate rich effluents and their possible impact on human health.	Impact of land application of industrial sludges on the quality of surface and groundwaters and soils for use in the development of suitable guidelines.	Analytical standards.
Type of Research Needed	Development of: - More specific, low cost sampling and analysis protocols. - Continuous monitoring methods - Total reduced sulphur calibration method	To identify the various species of Klebsiella in pulp and paper effluents and to determine their impact on human health and livestock. To develop analytical procedures to isolate and directly measure Klebsiella pneumoniae.		Synthesis, quantification and validation of standard reference compounds such as dioxins, furans, PAH's as required for MOE laboratories and not available commercially.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
11 Issue/ Subject	Real time monitoring of toxic airborne substances. Sufficient sensitivity for trace airborne contaminants.	Development of remedial measures to minimize the impact of agricultural practices on water quality.	Study of fate of hazardous contaminants in lanfill: - state of-the-art review. - field & lab studies. - contaminant half-life. - attenuation. - synergistic effects.	Development of resin samplers for preconcentration of low levels of toxic contaminants in surface and drinking waters prior to analysis.
Type of Research Needed	- Dioxin and other compounds sampling techniques need development	Detailed evaluation of specific structural, tillage and cropping practices, i.e. environmental and cost-benefit studies including energy use. To document impact of vegetative buffer strips adjacent to streams and municipal drains on water quality. To develop optimum design and construction of cost-effective buffer strips. To investigate the effectiveness of livestock controls and agricultural waste management practices on receiving water quality with respect to bacteria, phosphorus, and sediment loads.	- effect of disposal of industrial waste with municipal refuse on groundwater (physical and chemical interaction). - Impact of hazardous industrial wastes on landfills: migration, attenuation, etc.	- XAD and similar resin technology need to be extended and tested for a comprehensive range of trace organics. Rugged high flow field sampling systems need to be developed. - Evaluation of the capacity of resin system to recover total organic loading from waters and waste waters.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
12 Issue/ Subject	Correlation of monitoring data related to specific pollution sources.	The quantity and types of hazardous contaminants leached from plastic pipes and other compounds, coating etc., in contact is not well defined.	Studies on toxic hazardous waste schedule: - Assessment of existing hazardous waste schedule. - Development of criteria for listing of hazardous waste based on toxicological studies (chronic and acute toxicity, persistence, bioaccumulation, leachability, etc.)	Non-separative analytical methods for air analysis.
Type of Research Needed	- Application of receptor modelling techniques to some specific situations in Ontario to evaluate this methodology. - Development of methods to characterize emission sources in a way useful for receptor modelling.	To investigate potential trace contaminant leachates from piping, coatings and other material in contact with potable water. Inventory of materials, used in Ontario, in contact with drinking water e.g. piping, liners, paints, chemical additives and an assessment of the potential magnitude of contamination.		Rapid, specific, non-separative analytical methods need development. Tiered analytical systems of increasing resolution and sensitivity need further work.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
13 Issue/ Subject	Deposition and accumulation of airborne compounds.	The impact of agricultural tile drainage on receiving watercourses.		Tiered testing of groundwater for landfill investigations.
Type of Research Needed	- Deposition monitoring technology needs further development - Pathways of contaminants to fruits and vegetables via soil or air should be studied with respect to mercury, lead, boron, nickel, etc.	- To evaluate nutrients and solids transport under varying cropping and tillage conditions. - Study of the effects of tile drainage and open ditches on peak flows and dry weather flows.		- Development of a tiered testing protocol for groundwater contaminant analysis.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
14 Issue/ Subject	Uncertainty in calculating toxic compound concentrations downwind of emergency sites.	Sediments dredged from highly contaminated areas create the potential for environmental damage at both the point of dredging and disposal.	Accumulation of non-degradable organic and inorganic contaminants on land.	On-site sampling of gaseous emissions.
Type of Research Needed	- Comparison and validation of different models. - Effect of local topography on dispersion.	- Develop biological procedures to characterize materials to be dredged in order to select appropriate disposal procedures. - Evaluate dredging techniques and compare their effectiveness in terms of disruption of the surrounding aquatic environment.	- Studies leading to development of criteria for acceptable levels.	Further development of air sampling methods for both on and off-site measurements. Development of simple, rugged field analytical methods for landfill air contaminants emissions.

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
15 Issue/Subject	Formation, decay and reaction mechanisms of many primary and secondary pollutants.			
Type of Research Needed	- Study of intermediates in pollutant reactions; modelling of Atmospheric Chemistry including hazardous contaminants.			

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
16 Issue/ Subject	Relationship between indoor and outdoor air contaminants.		Evaluation of leachate treatment processes including marsh treatment designed for: i. landfill leachates ii. sawdust leachates, etc.	
Type of Research Needed	- Indoor air concentrations of different pollutants need to be assessed together with their relationship to outdoor measurements and the implications for abatement action based on outdoor measurements of selected contaminants.			

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
17 Issue/ Subject	Effects of accumulation of various pollutants, e.g. on vegetation, short or long-term.			
Type of Research Needed	- Establishment of dose response data for the effect of pollutants, e.g. ethylene, arsenic, nickel, SO_2, O_3, fluorides on different species. - Determination of long-term health effects.			

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
18 Issue/ Subject	Uncontrolled or inefficient processes may produce unwanted air emissions.			
Type of Research Needed	- Determination of most efficient generic processes for selected industries or plants, e.g. pulp and paper, some municipal incinerators.			

	AIR POLLUTION	WATER POLLUTION	LIQUID AND SOLID WASTE	ANALYTICAL METHODS
19 Issue/Subject	Dispersion from non-standard sources (e.g. mine tailings, fugitive emissions).			
Type of Research Needed	- Dispersion modelling for non-standard sources needs further development.			

New Additions to Research Needs Document

1) Issue - Characterization of the hazardous contaminants in combined sewage overflows (CSO's) and stormwater runoffs (SWR's) and development of optimal control options.

The Type of research needed:

- refine the relationship between land-use patterns, i.e., percent industrial, residential and commercial uses and the type and concentrations of hazardous contaminants in CSO's and SWR's;
- distribution of hazardous contaminants between solids and liquid phases in CSO's and SWR's;
- relationship between concentrations of hazardous contaminants in CSO's to rate and duration of overflows (i.e. the hydrographs). This would define the optimum volume of holding tanks for controlling hazardous contaminants in CSO's and SWR's;
- the rate of accumulation and identification of hazardous contaminants accumulated on urban land surfaces;
- the removability of selected hazardous contaminants in CSO's and SWR's by conventional means, e.g. solids removal and/or street sweeping;
- innovative techniques and mechanisms to effectively monitor and control hazardous contaminant discharges into sewer systems.

2) Issue - Innovative sewage treatment process research

Type of research needed:

Assessment of the Segmented Batch Reactor, Biological Phosphorus Removal and integrated sewage treatment and energy production plants.

3) Issue - Prediction of currents from wind data at locations where no current meters have been operated. Such predictions are often necessary for locations of small outfalls or spills.

Type of research needed:

Designing a model using wind and current data from the Great Lakes nearshore areas in order to predict current directions and speed for dispersion studies without the need for actual current measurements.

4) Issue - Development of a numerical/mathematical model to predict the extent and water quality of a river plume where it merges in the lake and loses its identity.

Type of research needed:

A model should be designed and tested to handle one or more rivers without or with some point sources under different climatological conditions.

5) Issue - Defining the fate and transport of bacteria, organic and inorganic compounds in the nearshore Great Lakes environment by incorporating the effects of physical processes of wind, temperature and nearshore currents.

Type of research needed:

The development of computer simulations and modelling techniques in the nearshore Great Lakes by studying the dispersion patterns of near-field and far-field discharges (industrial and municipal outfalls).

6) Issue - Fate and pathways of in-stream pollutants associated with solids.

Type of research needed:

1. Investigate relationship between suspended sediment and metals and factors that influence it.
2. Investigate contribution of sediment entrainment in rivers to bacterial levels.

7) Issue - Agricultural nutrient sources, transport

Type of research needed:

1. Investigate relationship between sediment erosion and phosphorus yields - overland delivery mechanisms.
2. Study phosphorus transport, retention and transformation processes in a Great Lakes tributary (biogeochemical cycling), and evaluate erosion and sediment control implications.
3. Provide cost-benefit analysis of diffuse source controls in Ontario.
4. Investigate the Holland River as affected by diversion of a major municipal point pollution source.

8) Issue - Economics of conventional road de-icing and alternatives.

Type of research needed:

Provide a comprehensive cost-benefit analysis to establish economy of salt usage (an alternatives to salt) in relation to damage to structures and environment.

9) Issue - Development of risk and reliability methods for evaluating wastewater assimilation.

Type of research needed:

- performance analysis of reservoir operation in lowflow augmentation.
- Bayesian risk decision in quantity and quality design criteria.
- reliability and trends in loadings in Ontario tributaries.

10) Development of regional water quality screening methods (indices/models) to identify potential water quality problems.

Type of research needed:

- industrial effluents and flow correlation for specified trace contaminants.

11) Quantifying uncertainty in nutrient/contaminant loadings in-stream and its projected impact on the Great Lakes.

Type of research needed:

- stochastic analysis of ambient water quality data.
- impact and uncertainty in long-term phosphorus loadings to Great Lakes.
- model development/implementation to investigate remedial measures scenarios.

12) Contaminant model development for mine tailing discharge assimilation and acid rain study.

Type of research needed:

- model implementation in Serpent River for various management scenarios.
- model implementation for investigating fate of acid rain in the Dorset-Haliburton Region.

13) Detection of pesticide residues in tributaries and their impact on the inland water system.

Type of research needed:

- frequency and trends in detections in selected tributaries (Grand/Saugeen/Thames).
- method to evaluate cause and effect relationship.
- screening model to evaluate likely management scenarios.

ISSUE 14: DRINKING WATER QUALITY OBJECTIVES AND TREATMENT PROCESSES

Type of Research Needed:

- Provision of information required for the development of drinking water quality objectives for MOE list of priority chemicals.
- Use of mutagenicity testing in assessing drinking water treatment processes - effectiveness/efficiency of treatment.
- To develop means of predicting/ establishing short-term variations in water quality at intakes and establishing subsequent treatment technology.

ISSUE 15: CASE STUDIES OF THE EFFICIENCIES OF SELECTED CONVENTIONAL AND ADVANCED WASTEWATER TREATMENT SYSTEMS CURRENTLY USED IN THE ONTARIO PULP AND PAPER, STEEL AND PETROLEUM/ PETROCHEMICAL INDUSTRY IN REMOVING HAZARDOUS CONTAMINANTS

Type of Research Needed:

- Identification and low-level quantification of selected contaminants of concern (e.g. PAH's - steel industry; resin and fatty acids - pulp and paper; chlorinated aromatics - petrochemical) in the influent and effluent streams of a variety of treatment systems (e.g. Biox, carbon filtration, aerated stabilization).
- Comparison of removal efficiencies of different systems and identification of major design and operating factors influencing removal.
- Evaluation of toxicity to fish and taste and odour/tainting potential of influent and effluent streams and identification of probable associations/correlations of these effects with the contaminants (and their levels) found.

NEW ADDITIONS TO RESEARCH NEEDS DOCUMENT
(LIQUID AND SOLID WASTE RESEARCH)

1. ISSUE - Lack of information on proper disposal of off-specification and expired waste pharmaceutical products.

Type of Research Needed:

- ° review existing waste types and volumes, disposal methods, and their potential environmental impacts.
- ° recommend appropriate disposal options of the various classes of pharmaceuticals (antibiotics, antineoplastics, steroids, etc.) and their MOE waste classification (i.e. hazardous or non-hazardous).

2. ISSUE - Research is required into the effects of on-going serial leaching of wastes in landfills. Current leachate tests only determine the concentration of contaminants that are initially released.

Type of Research Needed

- ° determine if the concentrations stabilize, increase, or decrease with time.
- ° evaluate a wide range of wastes and determine if the changes are significant and whether test methodologies should be developed for inclusion in MOE's regulatory program.

3. ISSUE - Research is required to inventory existing solidification technologies and the methods used in their evaluation.

Type of Research Needed

- ° identify criteria used by other jurisdictions to determine when a solidified hazardous waste can be considered non-hazardous, whether solidified wastes continue to retain contaminants in the long term, and the impact of freeze/thaw and wet/dry cycles on the wastes.

4. ISSUE - Under the interim hazardous waste definition, small quantity wastes (less than 5 kg./mos.) are exempted and can be disposed of at approved sanitary landfills.

Type of Research

- carry out a review to determine how small quantity wastes from laboratories and commercial establishments are being managed and the potential environmental impacts.
- determine whether small quantity exemption should be further reduced or even whether it should be increased.

ADDENDUM

REVISIONS AND ADDITIONS TO SCIENTIFIC RESEARCH NEEDS

(November, 1986)

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C. External Research Proposal Summary Form (Form 02)

A. 1986 REVISIONS TO 1984 SCIENTIFIC RESEARCH NEEDS

WATER POLLUTION

1. Issue:

Lack of information on distribution and behaviour of aquatic contaminants and the biological responses to contamination from industrial and municipal discharges and airborne contaminants.

Type of Research Needed: (additions to page 9)

- Development and calibration of mathematical models of methyl mercury accumulation by aquatic biota to clarify factors influencing uptake and elimination.
- Assessment of mercury methylation/demethylation rates in oligotrophic softwater lakes and their watersheds.
- Development of empirical models to describe the partitioning of mercury and methyl mercury by watershed soils, stream sediments and lake sediments of oligotrophic softwater lakes.
- Significance of elevated levels of mercury, other heavy metals and organic compounds on the growth and reproductive success of aquatic organisms.
- Assessment of the importance of modifying factors (hardness, pH, temperature) on the toxicity of metals and other substances.
- Significance (short and long term) of recent increases in nitrogen levels in Great Lakes and tributary waters.
- Evaluation of responses to decreasing phosphorus levels in the Great Lakes system.
- Procedures for determining and modelling the toxic effects of mixtures of chemicals found in effluents and ambient waters.
- Development of a predictive capability concerning the environmental impact (primarily toxicological) of goldmining effluents.
- Development of surrogates for rapid and effective monitoring of hazardous waste discharges.

2. Issue:

Standard protocol for prediction of fate and removability of hazardous compounds in municipal Water Pollution Control Plants.

Type of Research Needed: (addition to page 10)

- Grouping of hazardous substances using Quantitative Structure Activity Relationships (QSAR) or other techniques to categorize and reduce priority pollutant lists.

6. Issue:

The impacts of in-place pollutants in sediments on the aquatic ecosystem and human health.

Type of Research Needed: (additions to page 10)

- Effectiveness of alternative approaches to isolating, removing, treating and/or disposing of contaminated sediments.

- Development of procedures to assess biological uptake of contaminants from sediments.

8. Issue:

Information is needed on the impact of suspended solids and sediment on stream uses and the transport and fate of suspended solids in harbour/nearshore environments.

Type of Research Needed: (additions to page 16)

- Predictive models to identify depositional areas and areas of resuspension and transport in the nearshore zone of the Great Lakes.

- Significance of suspended solids on fish health (gill clogging, feeding behaviour, growth, etc.) leading to a suspended solids or turbidity objective.

- Bioavailability of metals and organics associated with suspended particulates.

9. Issue:

Impact of organic compounds in pulp and paper discharges on aquatic life and fish consumption.

Type of Research Needed: (addition to page 17)

- Development of rugged testing procedures for the analysis of trace organics in pulp and paper effluents for chemicals specific to the industry followed by assessment of effects on aquatic life.

AIR POLLUTION

Broad areas of interest for Air Research may be grouped into five categories:

1) Hazardous airborne contaminants.
2) New technology.
3) Atmospheric processes and fates.
4) Atmospheric monitoring of air and precipitation quality.
5) Instrumentation development.

These categories include large areas of scientific and engineering endeavour, not all of which are germane to the immediate needs of the Ministry. Thus, to be useful to decision makers as well as potential applicants, a more detailed description of each specific area of concern is included. To further focus the research grant process, particular problems appropriate to the area and their overall rank from the current research priority list are added to each section. These five sections are followed by the entire priority list, together with the research needs for each problem and other explanatory material.

1. Issue:

Hazardous airborne contaminants.

Type of Research Needed:

- Determination of sources, sinks and their strengths; atmospheric persistence and fate.

- Development of sampling methods.
  a) Toxic volatile organic compounds (VOC's).
  b) Toxic semivolatile organic compounds (SVOC's) in vapour form and on particulate matter.
  c) Organic compounds and heavy metals in airborne particulate and inhalable particulate matter.

- Effects and risk assessment of atmospheric contaminants on receptors.
  a) On humans.
  b) On vegetation/soils (phytotoxicology)
  c) On materials (corrosion, etc.).

Specific Problems	Priority
Hazard or risk due to airborne contaminants is often unknown.	1
Inhalable particulate measurements have not been related to human health.	2
Methods of risk assessment are inadequately developed in connection with air quality protection.	4
Inadequate information exists on the sources and fate of hazardous contaminants.	10
We do not know the effects of accumulation of various pollutants e.g. on vegetation, short or long term.	16
The application of economics and cost benefit analysis to air pollution control is insufficiently understood.	23
Some plant diseases can increase damage due to pollutants and vice versa.	28
In parts of Ontario, the soil has accumulated nondegradable contaminants.	29
Many decisions on safety standards etc. must be taken without complete information.	30
Some cultivars of white beans, etc. are particularly sensitive to air pollutants such as ozone.	31
Asbestos guidelines require electron microscope based techniques, health effect information is derived from optical microscope based techniques.	34
Handling and disposal of industrial waste lead to unwanted air emissions.	35
Effects of non-ionizing radiation on humans are largely unknown.	36

2. Issue:

New abatement technology.

Type of Research Needed:

- Gaseous pollutant control technologies.
- Particulate pollutant control technologies.
- Process developments yielding reduced emissions.

Specific Problems	Priority
Some processes, including uncontrolled or inefficient processes, produce unwanted air emissions.	18
Accurate, unbiased assessment of new control technologies is difficult to obtain, especially for contaminants of major concern in Ontario.	24
Relationship of noise and vibration levels to degradation of quality of life is not known.	33

3. Issue:

Atmospheric processes and fates

Type of Research Needed:

- Primary pollutants (gaseous and particulate)
  a) Formation processes of reactive substances
  b) Sink mechanisms and strengths (precipitation scavenging, dry deposition, photochemical degradation, etc.)
  c) Reaction kinetics, transport pathways and mechanisms
- Secondary pollutants (gaseous and particulate)
  a) Formation mechanisms
  b) Reaction kinetics
  c) Sink mechanisms and strengths
  d) Transport pathways and mechanisms
- Modelling of atmospheric chemistry
- Receptor modelling
- Meso-scale modelling of winds
- Transient release modelling (fires, chemical spills, etc.)

Specific Problems	Priority
Long range and meso-scale atmospheric transport modelling further development.	3
Ontario is heavily impact by sulphur and nitrogen from the atmosphere due to LRTAP.	11
Dispersion from non-standard sources (e.g. mine tailings, fugitive emissions) is not well understood.	17
We do not know the deposition of many airborne compounds.	19
Uncertainty in calculating toxic compound concentrations downwind of emergency sites.	21
Formation, decay and reaction mechanisms of many primary and secondary pollutants are not well known.	22
It is difficult to quantify boundary layer turbulence.	26
Ontario is so large that air quality and long range transport of many pollutants are difficult to quantify.	32

4. Issue:

Instrumentation Development.

Type of Research Needed:

- Samplers and monitors for trace and major atmospheric components.
- Source samplers and monitors, continuous monitors.
- Development of primary calibration standards.
- Meteorological instrumentation - boundary layer turbulence characteristics.
- Portable, sensitive field monitors for specific contaminants such as chlorine and inorganic chlorides, total reduced sulphur, and speciation of individual components, HF and flourides, PCBs, organic vapours, PAHs, etc.
- Deposition rate monitors.
- Development of reliable monitoring techniques requiring little supervision.

Specific Problems	Priority
There are toxic airborne substances for which we cannot monitor at all, or cannot monitor in real time.	5
Currently available techniques are not suitable for routine monitoring in more remote areas of Ontario.	7
Sampling methods can cause losses of compounds of concern; inaccurate measurements may result. Arsenic and other volatile metals and organometallics are present in ambient air but are difficult to measure.	9
Stack and emission samping is extremely expensive and each stack is sampled infrequently.	13
We do not have reliable odour monitoring.	14
We are not currently quantifying airborne particles which can penetrate to the lung.	15

5. Issue:

Atmospheric monitoring of air and precipitation quality.

Type of Research Needed:

- Ambient concentrations and deposition of hazardous substances.
- Development of monitoring methodologies for newly realized concerns.
- Indoor air quality.
- Development of monitoring methodologies for odourous compounds.

Specific Problems	Priority
Impact of residential woodburning on air and precipitation quality is not well understood.	6
Large quantities of monitoring data are generated but it is often difficult to know how these data are related to specific pollution problems.	8
It is difficult to assess human exposure to many contaminants using data from fixed central monitoring stations.	12

Relationship of indoor air quality to outdoor contaminant levels in Ontario is not well characterized. Indoor levels of many pollutants are not known. 20

Biological monitors have not been found for some compounds of interes. 25

Quantification of seasonal variation of trace elements/ compounds from Ontario power plants and large combustion sources is difficult to obtain. 27

AIR RESEARCH

Our objective is to ensure an ambient air quality in Ontario that will have no detrimental effects on human health, or on the natural environment.

Rank	Problem	Why Important	What Has Been Done	Research Needs
1.	Hazard or risk due to airborne contaminants is often unknown.	- Hazardous contaminants may be affecting human health and environment.	- Major activity in EPA, Michigan, etc. - MOE Priority Working Group is prioritizing compounds. - MOE Handbook Working Group is collating standards, monitoring and toxicology information.	- Study of contaminant effect on receptors, humans mammals, vegetation/soils, biological systems including short term tests. - Development of dose-response relationship and evaluation of its usefulness. - Novel method of collating and displaying hazardous contaminants information should be developed. - More receptor modeling.
2.	Measurements of inhalable particulate have not at present been related to human health.	- Cannot interpret data.		- Develop relationship between inhalable particulate and human health effect so that we can set standards, e.g. blood lead, asthmatic study.
3.	Long range and meso-scale atmospheric transport modeling needs further development.	- Necessary to predict impact of pollutants on receptors and assess contribution of different sources to air pollution problems.	- Extensive ARB work on this topic.	- Further model development.
4.	Methods of risk assessment are inadequately developed in connection with air quality protection.	- Need this information to protect human health, to set standards and make abatement decisions.	- Risk assessment group set up.	- Methodology of risk assessment with respect to air pollutant exposure needs development.

Rank	Problem	Why Important	What Has Been Done	Research Needs
5.	There are toxic airborne substances for which we cannot monitor at all, or cannot monitor in real time.	- These are toxic substances which may affect human health.		- Dioxin sampling needs development.
6.	Impact of residential wood burning on air quality.	- Emission from wood burning may have an adverse effect on human health and the environment.	- Substantial amount of monitoring and other studies in the U.S. and the Yukon.	- Special Study co-ordinated by ARB to determine impact of wood burning on air quality.
7.	Specific problem areas in Ontario cannot be adequately characterized with routine monitoring techniques.	- There are many citizen complaints in such areas and regional staff need specific information on which to base abatement action.	- Mobile monitoring units have been constructed. Monitoring and analytical methods have been developed for a range of compounds.	- Further development of mobile monitoring and analytical methods, extend the number of compounds, validate methods, etc. - Rugged, simple, field monitoring techniques should be developed for a variety of organic and inorganic compounds. - Passive sampling. - More work needed on techniques to accurately measure inhalable particulates.
8.	Large quantities of monitoring data are generated, but it is often difficult to know how these data relate to specific pollution sources.	- The effects of specific sources of pollution must be known for effective abatement action.	- Receptor modeling techniques are being developed in the U.S.	- Apply receptor modeling techniques to some specific situations in Ontario to evaluate this methodology. - Develop methods to characterize emission sources in a way useful for receptor modeling.

Rank	Problem	Why Important	What Has Been Done	Research Needs
9.	Current sampling methods can cause losses of compounds of concern. Inaccurate measurements can result. Arsenic and other volatile metals and organometallics are present in ambient air but are difficult to measure.	- Reported values for contaminants can be inaccurate and thus be unsatisfactory for health effects assessment or as a basis for Ministry action.	- New sampling method for PAHs is being developed. - Study underway on effect of handling conditions on sample tubes. - Impregnated filters for arsenic sampling available.	- Sampling methodology needs validation.
10.	Inadequate information exists on the sources and fate of hazardous contaminants.	- Cost effective abatement action can only be taken with adequate information.	- Acres study on chlorinated hydrocarbons. - MacKay fugacity studies. - Study on aromatic amines and azo dyes. - CCPA inventory. - VOC inventory. - Sudbury study.	- Determination of sources, source strengths, sink mechanisms and strengths, atmospheric persistence and fate.
11.	Ontario is heavily impacted by S,N acids from the atmosphere due to LRTAP.	- Effects on crops, aquatic bodies.	- Monitoring program has been set up, a number of special studies instituted.	- Further work to increase our understanding of atmospheric chemistry, deposition, e.g. studies of chemical reactions in clouds, studies of ozone formation around industrial areas in Ontario, wet and dry deposition measurements.

Rank	Problem	Why Important	What Has Been Done	Research Needs
12.	It is difficult to assess human exposure to many contaminants using data from fixed central monitoring stations.	- We need to know human exposure to assess human hazard.	- Some personal dosimeters have been developed for higher levels of contaminants in occupational situations. - Gage Institute assessing asthmatic lung function and relationships of indoor, outdoor air quality, central station monitoring.	- More sensitive personal dosimeters need to be developed for a greater variety of contaminants. - Examine relationships between fixed central stations measurement and human health effects.
13.	Stack and emission sampling is extremely expensive and each stack is sampled infrequently.	- Emission sampling is crucial for assessment of contaminants problems and eventual abatement action.	- MOE Source Assessment Protocol developed. - Standard EPA stack sampling protocols have been used. - TAGA used for continuous sampling of PCB burn. - Some continuous monitors are in operation. - Mobile van being developed for stack sampling.	- More specific, cheaper sampling and analysis protocols. - Continuous monitoring methods need development. - TRS calibration method needs development.
14.	Odours are a problem.	- Following up odour complaints is a major time commitment for regional personnel. Odours can contribute to a decreased quality of life in certain areas.	- Gynp is developing a predictive model for odours from fast food outlets. MOL is examining short term exposure guidelines. - Thompson developing lipid membrane organic measuring device (nasal analogue). - Odours monitored in some areas.	- Relate odour intensity and duration to complaints. - Develop odour monitoring technology to give more reproducible results, i.e. quantify odour. - Develop a basis for setting standards for odorous compounds.

Rank	Problem	Why Important	What Has Been Done	Research Needs
15.	At present, we are not quantifying those airborne particles which can penetrate to the lung.	- To assess the human health impact of airborne particles, it helps to know the amount which are of inhalable size, and which are not.	- Comparative study of inhalable particulate samplers completed by ARB. - Study in regional sites ongoing, to examine relationships between "total particulate" and inhalable particulate.	- Determine potential losses of volatile particulate from inhalable particulate samplers. - Develop a sampler that is reliable in measuring inhalable and respirable particulate continuously.
16.	We do not know the effects of accumulation of various pollutants, e.g. on vegetation, short or long term.	- Standards are set on the basis of the most sensitive receptor, which is often vegetation. We need this information to assess human health effects and phytotoxicology.	- Field studies and greenhouse studies carried out in controlled environments.	- Establishment of dose response data for the effect of pollutants, e.g. ethylene, arsenic, nickel, SO_2, O_3, fluorides on different species. - Determination of long-term chronic effects.
17.	Dispersion from non-standard sources (e.g. mine tailings, fugitive emissions) is not well understood.	- Many such sources exist in Ontario.		- Dispersion modeling for non-standard sources needs development.
18.	Some processes, including uncontrolled or inefficient processes produce unwanted air emissions.	- Emissions can cause environmental problems, odours, etc. e.g. in pulp and paper plants, combustion processes.		- Determination of most efficient generic processes for offending industries or plants, e.g. pulp and paper, some municipal incinerators.
19.	We do not know the deposition of many airborne compounds.	- Although the concentrations in air of some compounds may be acceptable, they can deposit on water or land and accumulate sufficiently to cause a problem.	- Number of soil, vegetation and sediment surveys have been completed for specific compounds.	- Deposition monitoring technology needs development. - Pathways of contaminants of fruits and vegetables via soil or air should be studied with respect to mercury, lead, boron, nickel, etc.

Rank	Problem	Why Important	What Has Been Done	Research Needs
20.	Relationship of indoor air to outdoor levels in Ontario is not well characterized. Levels of many pollutants indoor are not known.	- Most people spend largest part of the their time indoors.	- Gage Institute has monitored indoor, outdoor, personal, central station for SO_2, NO_x, particulate.	- Indoor air concentrations of many different pollutants need to be assessed together with their relationship to our action based on outdoor measurements, e.g. radon, formaldehyde.
21.	Uncertainty in calculating toxic compound concentrations downwind of emergency sites.	- Citizens may be harmed if evacuation distances are not well founded.	- Several models on line and on portable computers.	- Comparison and validation of different models. - Effect of local topography on dispersion.
22.	Formation, decay & reaction mechnanisms of many primary and secondary pollutants are not well understood.	- Effective control of these pollutants requires this information.	- Sudbury Environmental Study, NEMP, APIOS.	- Study of intermediates in the reactions; modeling of atmospheric chemistry including hazardous contaminants.
23.	The application of economics and cost benefit analysis to air pollution control is insufficiently understood.	- Abatement extremely expensive. Cost-benefit analysis is crucial to determine optimum solution to problems.	- Work on most effective method of SO_2 control from oil industry operations in progress at U of T. - Acid precip. screening model. - Oxidant strategy development.	- Economics of marginal improvements in control should be studied for various industry groups and related to total air quality situation in Ontario. - Methods of coupling cost benefit analysis, dispersion modeling and receptor risk. - More specific assessment studies of the benefit of particular abatement strategies and programs

Rank	Problem	Why Important	What Has Been Done	Research Needs
24.	Accurate, unbiased assessment of new control techniques difficult to obtain, especially for contaminants of major concern in Ontario.	- This information is needed to promote application of specific control technology in Ontario.		- Test prototype control or new concepts in host sites in Ontario. - Need research on basic chemical and physical processes by which controls work.
25.	Biological monitors have not been found for some compounds of interest.	- Biological monitors (plants sensitive to certain pollutants) are extremely useful for detecting certain types of pollutants.	- Some species, e.g. gladioli used in certain areas of Ontario. - Lichen studies.	- Develop biological monitors for compounds of interest.
26.	Difficult to quantify boundary layer turbulence.	- Boundary layer turbulence measurements necessary to estimate ground level concentrations of contaminants.	- Some special studies done for abatement purposes, e.g. Nanticoke, Falconbridge.	- Develop better methods to measure boundary layer turbulence as well as ways of extrapolating this data to model development.
27.	Quantification of seasonal variation of trace elements/compounds from Ontario power plants and large combustion sources difficult to obtain.	- Power plants are large sources; potential impact of these contaminants could be major.	- Some stack testing results of individual stacks available.	- Stack sampling in power plants and large combustion sources; sampling of ambient air in surrounding areas.
28.	Some plant diseases can increase damage due to pollutants and vice-versa.	- Large dollar value of crop loss in Ontario each year.	- Work at Guelph on interaction of blight and ozone.	- Study of interactions between different pollutants and plant diseases. - Increased emphasis required on forest effects of LRTAP.
29.	In some areas of Ontario, the soil has accumulated non-degradable contaminants.	- These areas cannot be used for normal purposes.		- Development of restorative methodology for rehabiliting areas contaminated with lead, mercury, nickel, etc.

Rank	Problem	Why Important	What Has Been Done	Research Needs
30.	Many decisions must be taken without complete information.	- Inadequate heuristics, (simple decision-making rules) may lead to non-optimal decisions.	- Diverse academic research.	- Study how real decisions are taken about abatement, etc.
31.	Some cultivars of white bean, etc., are particularly sensitive to air pollutants such as ozone.	- Large dollar value of crop loss in Ontario.	- Initial development of white bean resistant to ozone.	- Further development of plant species and cultivars resistant to ozone, SO_2, fluorides. - Evaluation of antipollutant chemicals to protect plant life.
32.	Ontario is so large that air quality and long range transport of many pollutants are difficult to quantify.	- Many pollutants may come from outside Ontario.	- Miller studied satellite imagery of incoming aerosols.	- Applications of remote sensing equipment to air pollution needs development, e.g. cross Arctic transport of pollutants, vegetation damage, stack emissions.
33.	Relationship of noise and vibration levels to degradation of quality of life is not well known.	- Important determinant in noise and vibration standards.	- Initial noise study completed. - Personal noise monitoring kit validated. - Literature search on vibration completed.	- Comparative study under controlled conditions. - Assessment of vibration and structural damage from railway sources.
34.	Asbestos guideline requires electron microscope based measurement technique; health effects information is derived from optical microscope based technique.	- Asbestos has been widely used in Ontario and a well founded guideline or standard is essential.	- Verma is developing standardized E.M. measurement technique.	- Relationship between E.M. and optical measurements needs to be well characterized. - Techniques for safe removal of asbestos.

Rank	Problem	Why Important	What Has Been Done	Research Needs
35.	Handling and disposal of industrial wastes can cause unwanted emissions.	- These emissions may contain hazardous contaminants, could affect the health of citizens in the area and are a cause of citizen complaints.	- Some monitoring by EPA. - Upper Ottawa Street landfill study.	- Characterize emissions from selected industrial wastes, both through laboratory studies and at landfill sites.
36.	Effects of non-ionizing radiation on humans largely unknown.	- There are many major sources in our environment, e.g. power lines, radio and TV transmitters, radar, ultrasonic devices, laser light.	- Information available on E.M. radiation.	- Quantify effect on humans and biota generally. - Collate information for standard setting.

ANALYTICAL METHODS

3. **Issue:**

Development and validation of sampling protocols for contaminants in surface and drinking waters.

Type of Research Needed: (addition to page 11)

- Evaluation of sampling and preservation techniques for purgeable and extractable organic analysis.

4. **Issue:**

Investigation and development of laboratory techniques to assess leaching potential of specific wastes for hazardous waste classification.

Type of Research Needed: (addition to Page 12)

- Investigation of alternate leaching procedures and development of procedures and protocols suitable for volatile and non-volatile organics.

9. **Issue:**

Surrogate parameters for water monitoring.

Type of Research Needed: (addition to page 17)

- Evaluation of effectiveness of surrogate parameters.

B. ADDITIONAL ISSUES

WATER POLLUTION

1. Issue:

Statistical significance in contaminant sampling.

Type of Research Needed:

- Statistical design for identifying non-compliance with Provincial Water Quality Objectives in areas of impact.

- Define and evaluate approaches to dealing with values less than the detection limit in a statistical data base.

- Procedures for optimizing sampling frequency for determining contaminant loadings for point source discharges and total contaminant loads to lake basins (e.g. Lake Ontario).

2. Issue:

Aquatic macrophyte and algal responses to anthropogenic and other controlling factors and the role of aquatic plants in nutrient and contaminant cycling in the acquatic environment.

Type of Research Needed:

- Relationship of shading effects of phytoplankton to macrophyte growth in nutrient rich lakes.

- Assessment of year-to-year variability of Dicotomosiphon growth and distribution in Lake Simcoe and determination of light requirements for this benthic alga.

- Control of potentially toxic blue-green algae by stimulating more balanced populations through phosphorus reduction or nitrogen manipulation.

- Factors affecting metal accumulation in filamentous algae in Georgian Bay and softwater lakes and the significance and fate of metals subject to bioaccumulation.

- Assessment of relationship between acidity and phosphorus utilization in acidic lakes, including phosphatase activity, herbivore effects and light, pH and inorganic carbon requirements.

- Development of simple techniques for identifying species and forms based on electrophoretic/enzymatic procedures.

LIQUID AND SOLID WASTE

1. Issue:

Clogging problems and failure of leachate collection systems at landfill sites.

Type of Research Needed

- Investigate the extent and severity of this problem in Ontario.
- Determine causes of clogging problems and failure of leachate collection system. Identify signs which may help to predict problems.
- Recommend remedial measures to restore the operation of leachate collection systems with problems.
- Develop design criteria to prevent clogging and failure.

2. Issue:

Future potential of landfarming of industrial waste as a treatment alternative.

Type of Research Needed:

- Conduct literature review on the feasibility of the process.
- Carry out field studies to monitor the environmental impact of such practice.

3. Issue:

Lack of data on Municipal solid waste with respect to its composition and rate of generation.

Type of Research Needed:

- Update the 1977 work performed by Birds and Hale.
- Conduct waste analysis, including moisture content, trace organics, heavy metals, and heating value.
- Determine per capita waste generation rate.

4. Issue:

Research is required on the optimum use of landfills after closure.

Type of Research Needed:

- Conduct review to determine options available to Municipalities, including costs.

5. Issue:

Lack of information on the attitude and behaviour with respect to participation in waste recycling.

Type of Research Needed:

- Conduct survey on attitude towards recycling.
- Recommend strategy that Ministry can follow to change attitude towards recycling.

6. Issue:

Lack of recycling in apartment buildings.

Type of Research Needed:

- Investigate reasons for lack of participation.
- Recommend solutions to promote recycling.

7. Issue:

Lack of information on efficiency of various recycling collection systems.

Type of Research Needed:

- Investigate existing operations with a view to improving productivity.

8. Issue:

Lack of utilization of cellulosic material as animal feed.

Type of Research Needed:

- Investigate the feasibility of using bacterial culture to convert materials such as paper mill sludges, cannery waste and cheese whey, into animal feed.

9. Issue:

Research is required regarding the viability of utilizing paper mill sludge as substrate (growth medium) for mushroom culture.

Type of Research Needed:

- Conduct laboratory-scale feasibility study.

10. Issue:

Availability of good topsoil for landfill cover is limited in many areas of Ontario, resulting in a need for fertilizing and mulching the final layer in preparation for seeding.

Type of Research Needed:

- Conduct literature review and field tests to determine if wood wastes and paper mill sludges can be used as soil conditioners for final cover at landfill sites.

11. Issue:

Lack of information on the glassification of hazardous waste.

Type of Research Needed:

- Conduct laboratory study to investigate the uptake of metals by glass and the leachability of the solidified mass.

12. Issue:

Lack of information on the possible re-combination of TCDD and TCDF from Municipal refuse incinerator off-gas upon cooling.

Type of Research Needed:

- Determine if such reaction is theoretically possible.

- Conduct field study to determine whether TCDD and TCDF would be re-formed in the incinerator off-gas upon cooling.

13. Issue:

Lack of information on the hydrogeology of particular hydrogeologic settings in Ontario.

Type of Research Needed:

- Conduct routine hydrogeologic investigations of particular hydrogeologic settings (e.g. the Oak Ridges moraine) to establish ground water flow paths, residence times, etc. that could assist in our understanding of the fates of contaminants introduced into these settings.

14. Issue:

Lack of re-use, recycling and recovery of waste materials, such as foundry wastes, slags, corrugated cardboard and waxed paper.

Type of Research Needed:

- Conduct survey to determine quantities of such wastes.
- Review and identify recycling options around the world.
- Develop realistic recycling opportunities for Ontario.

15. Issue:

The criteria for the listing of hazardous waste in Regulation 309 are based mainly on the concentration of specific contaminants and do not consider the environmental impact of the combined contaminants in a waste matrix.

Type of Research Needed:

- Review and develop biological test methods to be used for the classification of wastes.

16. Issue:

Recent amendments to Regulation 309 require the evaluation of representative samples of liquid industrial and hazardous wastes prior to registration with the Ministry. The existing sampler is found to be unsatisfactory.

Type of Research Needed:

- Improve existing and/or develop new representative samplers and sampling techniques for liquid industrial and hazardous waste.

17. Issue:

Incineration of PVC may lead to the production of dioxin.

Type of Research Needed:

- Conduct review to determine if this theory is valid.
- Investigate the feasibility of using other types of plastic material instead of PVC in the hospital.

18. Issue:

Biomedical Waste Disposal.

Type of Research Needed:

- Review alternatives to incineration of the disposal of biomedical waste.
- Develop lab testing protocol for the determination of infectious wastes.
- Review options for the disposal of infectious body fluids from funeral parlours.

SOCIO-ECONOMICS

1. Issue:

To develop methods to estimate the biophysical effects of pollution and determine their social importance and economic value.

Type of Research Needed:

- Comparative studies of methods to estimate consumers' valuations of environmental benefits.
- Estimating benefits from preventing contamination of groundwater-based drinking-water supplies.
- Studies to yield expressions for values of changes in risks to human health.
- Inventory of outdoor recreation participation data.
- Hazard and risk due to airborne contaminants; relationship between inhalable particulates and effects on human health:
  - a) adapt or develop dose-response functions to predict and quantify damages from specific pollutants, economic activities, development projects.
  - b) adapt or develop dose-response functions to predict and quantify beneficial consequences that result from abatement and protection activities.
- Quantify dose-response functions due to water pollutants.
- Assemble and test human health dose-response functions for toxic/hazardous waterborne and airborne substances.
- Document damages and adverse effects of solid waste disposal processes and systems.
- Documentation of private benefits of abatement technologies, systems programs and requirements.
- Distribution of environmental pollution effects over social and income groups.
- Experiments to determine actual willingness-to-pay, willingness-to-accept compensation behaviour.
- Contingent valuation surveys.

2. Issue:

To determine the costs and other economic consequences of pollution abatement programs.

Type of Research Needed:

- Studies to estimate the cost of treatment, storage and/or disposal of hazardous waste.
- Estimates of the overall costs of environmental management in agricultural production.
- Estimating the costs of controlling air emissions from fuel burning by households and commercial units.
- Empirical cost functions for new industrial abatement processes, solid waste processing, special waste treatment and disposal.
- Analysis of demand characteristics and elasticities for pollution abatement systems, services and equipment.
- Analyses of motivating factors for industrial and municipal decision-makers with respect to abatement/environmental protection programs.

3. Issue:

Procedures and methods to help identify and evaluate policies and strategies to deal with environmental pollutants.

Type of Research Needed:

- Application of Linear Programming Techniques to specific pollutants to identify cost-effective abatement strategies.
- Estimating producers' behaviour under different regulatory regions.
- Empirical design and testing of effluent charge schemes.
- Evaluation of sewer surcharge programs.

4. Issue:

Economic parameters and characteristics/industrial structure and performance.

Type of Research Needed:

- Estimation of price elasticities of demand for secondary materials.
- Determinants of innovation in pollution abatement/resource recovery technology.
- Economic, dimensions, structure and performance of industrial waste hauling, treatment and disposal "industries".

5. Issue:

Social implications of and public response to environmental contaminants.

Type of Research Needed:

- Develop understanding of the social and psychological impacts of individual and community exposure to environmental contaminants; evaluation of intervention strategies.
- Identify factors influencing the public's perceptions of risk associated with environmental contaminants.
- Develop and evaluate approaches for communicating to the public about environmental risk.
- Evaluate the effectiveness of public consultation approaches in different types of situations.

6. Issue:

Forecasting and evaluation tools and methodologies.

Type of Research Needed:

- Development, comparisons and applications of non-economic evaluation techniques.
- Comparisons of forecasting techniques and models to forecast:

  a) contaminant discharges/emissions;
  b) ambient contamination levels; and
  c) spills.

ANALYTICAL METHOD DEVELOPMENT

1. Issue:

Improved quantitative analysis of ultra-trace amounts of specific organic compounds in complex mixtures.

Type of Research Needed:

- Improved resolution in gas chromatography (GC) through development of new columns with novel stationary phases with high selectivity for priority pollutants.
- Construction of novel GC detectors or improving selectivity of conventional GC detectors for hazardous compounds.
- New and improved chemical techniques for the isolation of target compounds from complex matrices of many other compounds including structurally similar species that interfere with GC and GC-MS analysis.
- Extension of existing methods to handle new types of samples.
- Develop rapid speciation methods for the toxic 2,3,7,8-substituted congeners of chlorinated dibenzo-p-dioxins and dibenzofurans in complex mixtures containing both toxic and non-toxic congeners.

2. Issue:

Unambiguous identification of organic compounds in the environment.

Type of Research Needed:

- Improvements of GC-MS and other instrumental techniques for rapid broad-spectrum compound identification in extremely complex mixtures.
- Improvements in identification of unknown organics from mass spectral information when library search methods are inadequate.
- Development of mathematical and software techniques to extract maximum structural information from GC-MS data.
- Identification using specialized mass spectrometric techniques such as positive and negative chemical ionization, exact mass determination, and MS-MS.

- Development of isolation and concentration techniques to obtain large quantities of unknown components to enable a wide variety of spectroscopic techniques to be used for compound identification.

3. Issue:

Improve speed and reliability of GC-MS data interpretation for quantitative target compound analysis.

Type of Research Needed:

- Develop software techniques to improve reliability of automated identification of trace levels of analytes using a few characteristic ion masses by selected ion monitoring.
- Improve software methods for automated target compound quantitation using external or internal standardization and automated report generation.
- Develop customized software packages for GC-MS data interpretation for specific Ministry programs, including specialized data bases.
- Develop identification procedures using combined retention time and mass spectral data.

4. Issue:

Determination of sample integrity during shipping and storage.

Type of Research Needed:

- Determination of optimum conditions for shipping samples including time limitations, temperature effects, container design, addition of preservatives during sampling.
- Determine sample integrity during length of storage time under different conditions, especially for volatile organic compounds.

5. Issue:

Improve sample throughput and analytical precision by automation of sample preparation.

Type of Research Needed:

- Application of robotics to sample preparation operations.
- Development of new extraction/wet chemical techniques more readily adapted to automation.
- Adaptation of existing chemical cleanup methods to automated procedures.

6. Issue:

Standard Reference Materials (SRM's) for organic trace analysis.

Type of Research Needed:

- SRM's are needed for many organics/sample types for which none are available commercially. Specifically, SRM's are needed for chlorinated dibenzo-p-dioxins/dibenzofurans in soils, sediments, incinerator fly-ash and water.

7. Issue:

Investigations of sample integrity after sub-aliquoting/homogenization.

Type of Research Needed:

- Investigation of the effects of grinding and homogenization on homogeneity of sample and particle sizes.
- Studies of analyte losses through sample homogenization steps.
- Investigation of the homogeneity of an aqueous sample in the presence of suspended particulates during sample sub-aliquoting.
- Problems associated with splitting filter and polyurethane foam cartridge d samples for air particulate.
- Analysis development of protocol for sub-aliquoting complex samples for round robin samples.

8. Issue:

Stability of analytical water samples with time.

Type of Research Needed:

- Comprehensive assessment of the stability with time of all inorganic and organic parameters routinely reported by MOE.
- Study design, associated analysis, report presentation.
- Development of improved procedures where current techniques prove inadequate.

FORM 02

ONTARIO
MINISTRY OF THE ENVIRONMENT

External Research Proposal
Summary Form

This form is to be completed by the applicant for the benefit of the Ministry. It is not a substitute for the detailed submission prepared by the applicant and should accompany that submission. The form should be completed by a contractor, consultant or university investigator submitting a solicited or unsolicited proposal for funding by grant or contract.

The detailed submission for an unsolicited proposal must include a sufficiently extensive report of the background literature to justify the position taken in the request for funding. All submissions should include a detailed cost breakdown by years, statement of experience, list of publications, and curriculum vitae. Provide information on consultants or other experts who would be hired and a full description and objectives of the proposed study.

While grant recipients are encouraged to publish the results of their work until the project has been completed and the final report released, permission must be obtained from the Office of Research prior to the release of any data from the projects.

INFORMATION TO APPLICANTS REQUESTING SUPPORT FOR THEIR PROPOSAL BY MEANS OF A GRANT OR CONTRACT

It is agreed that the information outlined in Revision No. 5 of the publication, "Information Booklet on Grants and Contracts and Instructions for Contract Liaison Officers and Grant Liaison Officers," issued by the Ministry of the Environment, apply to any grants or contracts made pursuant to this application and the conditions described in the booklet are hereby accepted by the applicant and the applicant's employing institution. These conditions are as follows:

CONDITIONS OF AWARD OF GRANT OR CONTRACT

In the event that a grant or contract is awarded, the applicant and his/her institution agree (to) (that):

1. Provide the Research Advisory Committee, Ministry of the Environment, with a written report on the work completed during the fiscal year that the grant was held and with copies of all reports or publications resulting from this project.
2. Provide an audited statement of expenditures at the end of each fiscal year to the Liaison Officer.
3. Provide to the Liaison Officer at the end of each fiscal year a list of capital equipment purchased with grant monies.
4. Return all capital equipment purchased with grant monies at the completion of the project or, alternatively, make some other suitable arrangement in writing with the Research Advisory Committee if the equipment will continue to be used to carry out related work.
5. Immediately notify the Liaison Officer of any change in the scope or nature of the work program, and return all funds to the Ministry not required to carry out the approved, revised program.
6. Return to the Ministry all grant funds remaining at the completion of each Fiscal Year or at the completion of the project.
7. There will be no stipend or salary paid to the Principal Investigator(s) from the grant.
8. The applicant agrees to provide a progress report every six months in addition to a final report which details the entire project and must be approved by the Ministry.
9. No overhead will be paid or accepted in connection with this grant.
10. Allow an Ontario Provincial Government Auditor access to the financial records of the project either during or after its completion.
11. The signatures below indicate that the contractor or grantee is committed to present a paper on the subject of the study at a conference after completion of the project if requested by the Ministry of the Environment.

DEAN, HEAD OR CHAIRMAN: ______________________________
Name Signature Phone Number

PRESIDENT OR PRINCIPAL: ______________________________
Name Signature Phone Number

DIRECTOR OF RESEARCH ADMINISTRATION: ______________________________
Name Signature Phone Number

FINANCIAL ADMINISTRATOR: ______________________________
Name Signature Phone Number

APPLICANT: ______________________________
Name Signature Phone Number

RESEARCH PROPOSAL SUMMARY

PROPOSAL NO. ______ PROJECT NO. ______

PROPOSAL TITLE:

PROPOSAL IDENTIFICATION: This proposal is submitted as:

(a) Solicited (requested by MOE) ____________________

(b) Unsolicited (not requested by MOE) ____________________

(c) Funding requested as a contract ____________________

(d) Funding requested as a grant ____________________

CONTRACTOR OR GRANTEE:

PRINCIPAL INVESTIGATOR AND AFFILIATION:

SPECIALISTS:

BUDGET:	YEAR #1	YEAR #2	YEAR #3	TOTAL
Salary:				
Travel:				
Supplies:				
Equipment:				
Overhead (Not paid to universities):				
Services:				
Other (specify):				
TOTAL:				
Total No. of Mandays				

CURRENT OR PREVIOUS RESEARCH FUNDING:

Has this proposal or one similar to it been submitted elsewhere for funding?

Yes ______ No ______ If yes, where?

Has it been accepted? Yes ______ No ______ If yes, approved funds: ________

No. of years __________

SUBMITTED BY: ______________________________ DATE: ______________

NAME: ______________________________ TITLE: ______________

ADDRESS: ______________________________ PHONE NUMBER ______________

.../

OBJECTIVES OF THE STUDY:

YEAR 1 OF STUDY

DESCRIPTION:

ANTICIPATED RESULTS:

YEAR 2 OF STUDY

DESCRIPTION:

ANTICIPATED RESULTS:

YEAR 3 OF STUDY

DESCRIPTION:

ANTICIPATED RESULTS:

.../

COMPLETE STUDY

OBJECTIVES:

DESCRIPTION:

ANTICIPATED RESULTS:

POTENTIAL FOR IMPLEMENTATION OF RESULTS:

OUTLINE OF BENEFITS:

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